CONTENT LINES IN DESIGN OF CHEMICAL EDUCATION FOR WOULD-BE ENGINEERS

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Abstract

Methodology of chemical education for would-be engineers in technical universities is discussed in the report. Content lines as an instrument of structuring of content of chemical courses are proposed by the author. Content lines and their practical implementation in syllabus are analyzed. It was shown that the method of syllabus design makes education area more transparent for all participants of educational process.
Key words: *content lines, engineering education, curriculum design.*

Introduction

Chemistry is an obligatory unit in curriculum for students of almost all technical specialities in the Republic of Belarus. Usually duration of the unit is one or less often two semesters in the first year. Depending on speciality it includes 32 or 50 hrs of lectures and 16 or 32 hrs of laboratory classes. Traditionally the content of chemical education for would-be engineers is based on the general chemistry course and it is not strongly connected with future professional activity of the students and their every-day life. This is one of the reasons for the low motivation of students to study chemistry. Most of them simply do not see the practical applicability of chemical knowledge. Another reason is that the admission procedure to the technical universities includes entrance exams (centralized testing) in Belarusian or Russian language, Physics and Mathematics. Matriculants do not pass entrance exams in Chemistry and as a result they pay less attention to graduate classes at school. At the same time it is obvious that the quality of chemical education will determine the overall level of skills of the future engineer.

The number of students of engineering specialities in the Republic of Belarus is very large. In 2014 according to official data 11,539 students were enrolled at universities to specialities in section "Technics and Technologies" and 3,066 students were enrolled to specialities in section "Architecture and Civil Engineering" respectively. This was 24,7 % of the total matriculants in Belarus (Higher education…, 2015, p. 19). For this reason, the problem of design of chemical education for would-be engineers is of current interest.

Methodology of research

The content of the chemical education for would-be engineers in Belarus has been studied since the 1930's to the present. Foreign practices in organization of chemical education in technical universities have been analyzed. At the same time detailed questioning of students of technical specialities to determine their attitude to the Chemistry was held in 2010 (1,048 respondents) and in 2013 (85 respondents).

Results of Research

The study found that the most common model of the course in chemistry for would-be engineers is a traditional course in general chemistry. The main topics were determined in its main features in 1960's. The short description of the course includes stoichiometry, atomic structure and bonding, thermodynamic, kinetics, equilibrium, solutions, ionic reactions, electrochemistry, corrosion of metals and protection methods, electrolysis, polymeric materials. However, the survey results showed that the content of the course is necessary to significantly revise.

Firstly, only about 30 % of the respondents believe that chemistry will be needed in their future activity. That is why special attention should be paid to the connection between the content of chemical education and peculiarities of professional tasks of the engineering careers.

Secondly, a little more than 50 % of respondents are confident that knowledge in chemistry is helpful in every-day life. Hence chemistry course should finally convince all that chemistry is a useful and applied science.

Thirdly, up to 70 % of respondents believe that chemistry is the most responsible science for world's environmental problems. Only about 10% of respondents blamed physics for these. It means that we have to show not only the role of chemistry in the pollution of the environment. But above all we need to demonstrate the importance of chemistry for solving environmental problems.

So, there is a problem how to organize such a diverse educational material in relatively short duration of a chemistry course. In Brest State Technical University *content lines* were used by the author as an instrument of structuring of content of chemical education for would-be engineers. Content lines form the template of syllabus of chemistry course. There have been used the following lines:

– substance: composition, structure and properties,
– chemical process: energetics, rate and equilibrium,
– chemical methods of identification and quantification of substances.

These three lines form invariant part of syllabus for students of different specialties. They correspond to classical course of general chemistry. Also three additional lines were proposed:

– chemistry and engineering as an area of future professional activity,
– chemistry and environment protection,
– chemistry and every-day life.

These three content lines form variable part of syllabus. They help to adjust the content of chemical education to needs of future profession of students. Fight against prejudice with regard to chemical science is another important role of these lines. And of course they help students to realize significant role of chemistry in sustainable development and environment protection.

Some examples of practical implementation of content line *chemistry and environment protection* for students specialized in operation of cars and vehicles are given in table 1.

Table 1. Description of environment problems in syllabus in General Chemistry.

Topic	Content
Chemical Thermodynamics	Calorific value of the fuel, biofuel, ethanol: heat of combustion and fuel balance, rapeseed oil as a raw material for the production of diesel fuel, environmental and ethical issues of biofuel production
Chemical Kinetics	Oxygen sensors and catalytic converter
Solutions	Automotive antifreeze: the ethylene glycol poisoning
Electrochemistry	The disposal of waste batteries; lead-acid battery: construction of battery and environmental issues, the lithium-ion batteries: construction and environmental problems, fuel cells in solving of the energy problem
Chemistry of metals	Environment problems of modern metallurgy, heavy metal compounds as environment pollutants
Polymers	Specificity of waste plastics, degradable polymer materials, combustion and pyrolysis as methods of polymer waste management, recycling of polymers

Conclusions and Implications

Content lines make education area more transparent for the students. They provide that syllabus in general chemistry becomes more holistic and understandable both for students and for professors. The results of questioning of the students held after final exam show that up to 90 % of the respondents improve their attitude to chemistry as a science.

References

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